The
RIGHT ALLOY
in the
RIGHT PLACE



## HYBNICKEL

TRADE MARK

### ALLOYS

A few typical illustrations showing application of various Hybnickel Alloys for extreme service

#### ARLINGTON BENSEL

Exclusive Sales Agent

for

VICTOR HYBINETTE

300 Madison Ave. New York City

THE Pusey & Jones Co." in whose plant the Hybnickel alloys are made under the direction and control of our own scientific organization, are well known as builders of ships and paper making machinery. Their extensive plant facilities, made available to us, enables us to produce a wide range and variety of alloy product. In this complete plant we employ methods the facilities for which would be quite impossible to provide in a plant laid out and operated exclusively or confined strictly to the manufacture of special alloys. In small castings of Hybnickel we have made 500 in a single day. We have also made single castings of nine tons and can make them much heavier. Here are facilities to machine, polish, weld, forge and test our products directly on the premises irrespective of size and weight.

The pattern shop is equal to any problem no matter how intricate. So is also the molding and casting organization. The close affiliation with the Pusey & Jones Co., which has now been in effect for nearly four years, is a vital part of our organization, giving our customers the assurance that here are facilities which very few other special alloy makers can offer.

#### > FOREWORD ~



HYBNICKEL is the registered trade name for a series of alloys with nickel and chrome as the main constituents which have been invented by and are now manufactured by Victor Hybinette.

Since their introduction over three years ago Hybnickel Alloys have made practicable numerous new and economical manufacturing methods heretofore considered impossible.

The lifelong experience of Victor Hybinette in the metallurgy of nickel together with the proven facilities of his research laboratories now enables us to offer you real assistance in handling your problems involving the use of alloys.

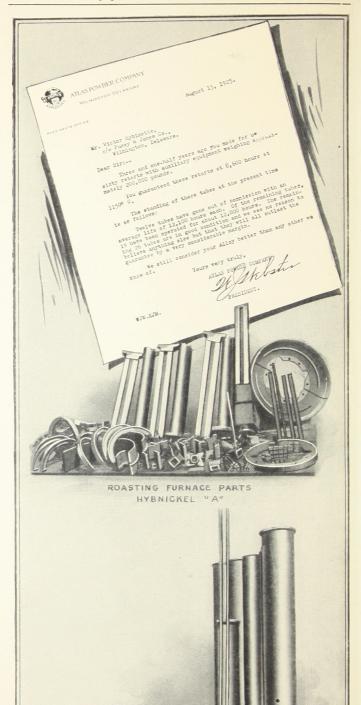
Hybnickel castings are made in all forms, shapes and sizes from a small furnace bolt or carbonizing box to a ten-ton tube or retort.

It is now an established fact that no single alloy is suitable for all purposes. Hence our practice is to review each application with sufficient study and analysis to insure utmost economy. This practice also assures the user of the Hybnickel Alloy best suited to his particular requirement.

Although the following pages describe a few distinctly different types of alloys designated as Hybnickel A, B, C, D, etc., there are within the scope of our activities ways and means to fill any reasonable requirement for production of castings, forgings, rods, wire and sheets for practically all purposes requiring resistivity to chemical action under varied conditions of heat and pressure.

An opportunity to review and assist you in your alloy problems will be appreciated.

ARLINGTON BENSEL



PART OF SHIPMENT OF 62 HYBNICKEL "A" TUBES

# Hybnickel A

HYBNICKEL "A" is defined as a general utility alloy, supplied in all forms, heatresisting under ordinary furnace conditions at an oxidizing or reducing temperature of 2100° F., and recommended for 10,000 hours under continuous heating or 3000 to 4000 hours under intermittent heating.

This standard heat-resisting metal has proved itself capable of standing up under a temperature of 2100° F. for more than 15,000 hours, a heretofore unheard of record. (See testimonial from Atlas Powder Co.)

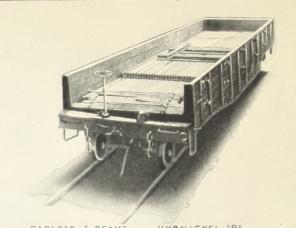
It is varied in its composition so as to produce either malleability for forging and rolling or machining or compounded so as to obtain great stiffness and non-warping qualities as desired.

Hybnickel "A" is recommended for carbonizing boxes, enamelling racks, retorts for purposes where alkali compounds do not interfere, hearth plates, skid rails and furnace conveyor parts, etc. Its ordinary physical properties are:

Tensile strength forged, 100,000 lbs.; cast 50,000 lbs. Elastic limit forged, 70,000 lbs.; cast, 40,000 lbs. Elongation in 2" forged, 25%; cast, 0-15% varied as desired. Weight per cu. ft. forged, 490 lbs.; cast, 480 lbs. Brinell Hardness—170-300, varied as desired. Pattern maker's shrinkage, ¼" per foot. Expansion between 0°-2000° F., ½" per foot. Coefficient of expansion 0°-2000° F., 0.0005% per degree F. Strength or fiber strain allowed without permanent

> at 1500° F., 6000 lbs. at 1800° F., 2000 lbs. at 2100° F., 600 lbs.

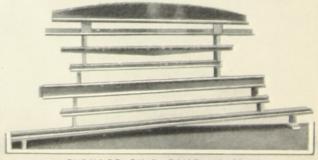
Heat Conductivity 1/40 that of copper. Electrical Resistivity at 20°C., 650 Ohms per Cir. Mil. Ft. Specific Heat Cal. per Gram per °C .110.



CARLOAD I-BEAMS - HYBNICKEL "B"
USED TO SUPPORT BEAMS IN OIL CRACKING STILL.



COLUMNS FOR SUPPORTING TUBES IN OIL STILL.



FURNACE SKID RAILS AND BEAMS HYBNICKEL "B"

## Hybnickel B

PATENTS PENDING

The Highly Rigid Alloy

THIS alloy has been specially compounded to produce the highest possible rigidity at temperatures up to 1800° F. It is not recommended for higher heat. Its usefulness is limited by its hardness and rigidity which can only be modified at the expense of its strength.

The figures designating the strength of ordinary structural material are well known and well understood—tensile strength, elastic limit, elongation, etc. When it comes to metals used for structures, subjected to high temperature, an entirely different set of figures must be obtained and an entirely different terminology must be used.

When a metal is worked under ordinary temperature it hardens and becomes stronger. When heated above the annealing temperature such hardening does not take place and the metal becomes elongated and weaker. With the same load a continuous stretching takes place until the specimen finally breaks. The element of time does therefore enter very materially for testing metals at elevated temperatures, and unless this element of time is taken into consideration the figures obtained are entirely too high. We have therefore constructed special testing apparatus where very small stretch can be recorded and where the load may be continually kept on for hundreds of hours. The figures above shown have been determined in this way and our product is continually tested.

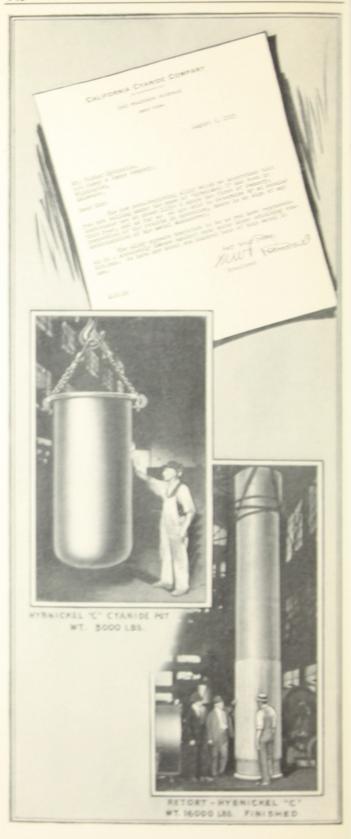
This alloy is almost non-machinable.

Brinell hardness—340. Strength under heat or fiberstrain allowable without permanent deformation:

at 1500° F., 10,000 lbs. per sq. in. at 1800° F., 6,000 lbs. per sq. in.

These figures should be understood not to include any factor of safety. We recommend a safety factor of 3. In all other respects the physical properties of Hybnickel B are similar to Hybnickel A.

Between 1000-2000 beams and supports have been sold mainly for oil cracking stills during the past two years without a single failure.



## Hybnickel C

PATENTS PENDING

Heat Resisting Alkali-Proof Alloy

THIS is a new composition discovered within the last year which embodies the highest possible heat-resistivity of any chrome-nickel or chrome-iron-nickel alloy, at the same time it has been found to be the only heat-resisting alloy which is practically immune to the influence of alkali compounds at high temperatures.

Contrary to the common belief that nickel-chrome-iron alloys are not resistant to the action of alkali compounds either caustic, carbonate, silicate or cyanide, we have found through a series of painstaking experiments that within a certain narrow range an alloy of iron, nickel and chrome is practically immune to these influences and also that this particular range of composition carries with it the highest possible degree of heat resistivity of any of the possible combinations of nickel and chromium with or without iron.

We have constructed retorts weighing 16,000 lbs. to carry a load of 10,000 lbs. on a twenty-foot span, for operation at 2100° F., and to handle a half molten soda mixture.

This alloy is varied in its composition so as to produce either malleability for rolling and forging or machinability or great stiffness.

It is recommended for high duty service where other heat-resisting alloys fail.

In its soft malleable form it has a tensile strength of 135,000 lbs. with 35% elongation.

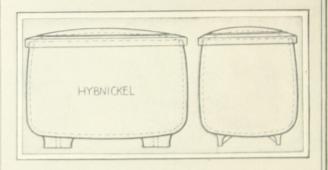
In its hard form it has the strength of Hybnickel B, but its strength at 2100° F. is about 1000 lbs. permissible fiberstrain.

In all other respects it has the same physical characteristics as Hybnickel A.

In the few months this alloy has been on the market over 100 tons have been sold.



HYBNICKEL "D" CARBONIZING BOXES





VIEW IN PATTERN SHOP

# Hybnickel D Carbonizing Box Alloy

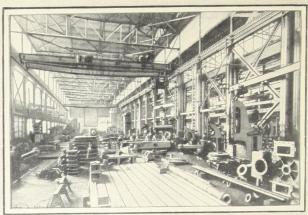
TYBNICKEL D is a less expensive alloy for temperatures around 1650-1800° F. It is particularly recommended for carbonizing boxes. It will endure 2000° F. for shorter periods. It is soft and malleable and suitable for intermittent use.

For physical properties see Hybnickel A.

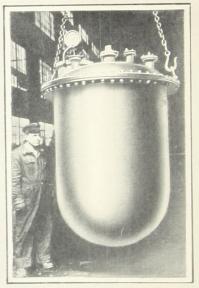
It has been claimed for chrome-nickel-iron alloys heretofore used for carbonizing boxes that they were non-warping, non-scaling, non-cracking and non-carbonizing. Analysis of the true situation reveals the fact that all alloys of this character absorb carbon, but to a lesser extent and at a very much slower rate than steel.

We have noticed a number of boxes which have been in use for a few thousand hours and independent of their different compositions we have found that if the alloy has originally contained about .8% carbon,  $\frac{1}{16}$ " on the inside of the box has been found to contain about  $2\frac{1}{2}$ % carbon, the next  $\frac{1}{16}$ " 2%, the next  $1\frac{3}{4}$ %, the next  $1\frac{1}{2}$ % and in a box with a 3/8" wall we have traced an increased carbon content as far out as 1/4", leaving only the last  $\frac{1}{8}$ " still containing the original amount of carbon. If the original alloy is given a higher carbon content this absorption of carbon is slower, but on the other hand a high carbon alloy is more easily subject to cracking under sudden temperature changes or uneven heating and cooling, and its use is therefore not advisable.

It is evident that an absorption of carbon carries with it an increased volume. It is this absorption of carbon that makes a square box cave in simply because the inside part of the metal increases in volume and causes bending of the surface toward the inside. This phenomenon has heretofore been incorrectly interpreted, being considered to be ordinary warping caused by too soft a metal. Hybnickel "D" is the result of our research in this line, and the boxes we are at present making are compounded with a view to combining a composition of alloy with a novel shape of box with convex walls and bottom.



VIEW IN MACHINE-SHOP



HYBNICKEL "R" ACID - RESISTING POT



VIEW IN FOUNDRY

# Hybnickel R

Acid-Resisting Alloy for Sulphuric and Similar Acids



YBNICKEL "R" fills the requirement for an alloy highly resistant to 50% sulphuric acid under pressure.

Here is another typical example of what has been accomplished through research and development by the Hybinette organization. A pot, the weight of which is 4000 lbs., having a capacity of 150 cubic feet, used for boiling with 50% H2SO4 under pressure, is estimated to lose but six grams of its weight with every charge of twenty-four hours duration. This pot, which is one of several supplied for a special chemical process, marks another advance in the development of alloys for a particular application.

The alloy is soft and malleable. Brinell No. 96— Tensile Strength, 50,000 lbs. Yield Point, 35,000 lbs. Elongation 10%.

This alloy is superior to any other material now known to us for resistance to many organic compounds, including citric acid, oxalic acid, iodides and iodates. It is also unusually resistant to dilute hydrochloric acid at temperatures of about 100° C. and below, but cannot be recommended for hydrochloric acid at higher temperatures and greater concentration

It is, however, known that small impurities of apparently very innocent character often cause surprising changes in acid resistivity. We must therefore strongly recommend that experiments of this character must be carried out under exact working conditions.

# Hybnickel S

Nitric Acid Resisting Alloy



THIS alloy is practically immune to the action of all kinds of nitric acid at all temperatures and all concentrations.

Physical properties—

Tensile Strength—75,000 lbs. sq. in.

Elastic Limit—50,000 lbs. sq. in.

Elongation—15%

We have searched the chrome-nickel series of alloys for the peak of resistivity to oxidizing compounds such as nitric acid, ferric salts, mine-water, etc.

Hybnickel S is the result. It can be forged and machined.

Sulphuric acid attacks the alloy readily, but with some oxidizing compound added, such as for instance 5% nitric acid, the alloy becomes immune.

It is not immune to Hydrochloric acid or aqua regia.

HE characteristics of cast iron, semi steel, tool steel, structural steel and wrought iron are commonly known. Many alloys, particularly those with which we are concerned, having for their base metals of the iron group, run through the same scale of transformation. It may even be said that a greater number of different properties may be developed in these alloys than in iron and steel. The characteristics necessary in carbonizing boxes, cyanide pots, beams to carry great weights at high temperatures, are examples of alloys, each of which must be compounded for a particular kind of service just as a knife blade is made of tool steel rather than of

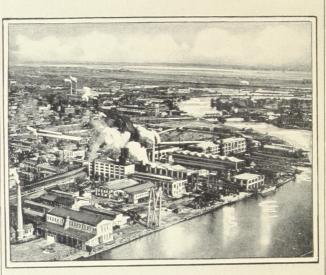
Up to four years ago it was considered absolutely impossible to subject an alloy plate or tube to a temperature of 2100° F. continuously without any deterioration of consequences such as scaling, grain growth, warping, etc.

Not only has Hybinette solved this problem but he has demonstrated great economies over more expensive alloys previously considered the best for resisting such extreme temperatures.

Hybnickel "A" tubes installed in the plant of the Atlas Powder Company about three years ago have shown to date an average life of about 15,000 hours.

This establishes a new endurance record on alloy retorts and places Hybnickel "A" at the head of the list for economy. Remember these tubes are still in use and going strong.

Our practice employs science in the thorough analysis and review of the work to be performed, followed by rigid technical control of every operation in the making of Hybnickel alloys.



PLANT OF PUSEY & JONES CO.
WILMINGTON-DEL.
IN WHICH HYBNICKEL CASTINGS ARE PRODUCED.

